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Machining a Large Albro Worm in a Small Lathe

By R. J. Mullin

During the summer of 1906 the North Coast Engineering Co., Seattle, Wash., was given a rush order for work on a steamship that was undergoing repairs at one of the marine shops. Among other things was a new worm of the Albro type, which was required for the steering engine, as in Fig. 1. Without ceremony of any kind the marine shop sent us a rough casting of the worm gear and a requisition calling for a finished worm in the shortest possible time. They stated that the shaft centers were 15 in. apart, but quite neglected to mention that they had attempted to cut one themselves and also omitted the usual request for a price in advance.

We had several A1 machinists, and our equipment was good as far as it went. Suggestions as to how that worm could be cut came thick and fast and were excused for cause just as rapidly, until finally nearly all gave it up. Presently I got an inspiration, and when the clanking of bar iron, the hum of the drilling machine and the rattle of bolts and nuts and wrenches had subsided, the Hamilton engine lathe was set up in a comparatively short time as shown in plan in Fig. 2.

As shown in Fig. 1, the thread of the worm must fit every tooth of the segment that it covers, also center lines drawn between the teeth of the gear and radiating from its center become the center lines of the thread at the point of contact. This means that the tool must have a length equal to the radius of the gear (12½ in.) and must swing from a fixed point corresponding to the center of the gear.

The outrigger bars *A*, Fig. 2, were cut off and drilled, and shallow grooves were cut across them where they rested on the shear strips. They were then firmly bolted to clamps beneath the lathe bed. The swivel-based vise *B* from the miller was placed on the outrigger bars with the center line *D* exactly 15 in. from the center line of the lathe. The tool *C* was the part requiring the greatest accuracy. It was made from a piece of 1-in. square steel, approximately 26 in. long. Since this worm was 1⅛-in. pitch and the coarsest lead the lathe would give was 1 in., it became necessary to proportion the two ends of the tool from the following formula:

$$9 : 8 = 12.5 : x, \text{ and } x = \frac{12.5 \times 8}{9} = 11\tfrac{1}{9}$$

this giving the length of the tool from the index line *E* to the slotted hole *F*.

A shoulder stud was made to fit in this slot, so that the length between *E* and *F* could be regulated as the cutting progressed. The reach rod *G* was connected to the stud in *F* and to the arm *H*, which was rigidly fastened to the carriage *I*. The rest *J* was placed under the tool and the set-up was complete. The lines *D* and *E* were a perfect guide for all adjustments.

FIG. 1. ALBRO WORM FOR STEERING ENGINE

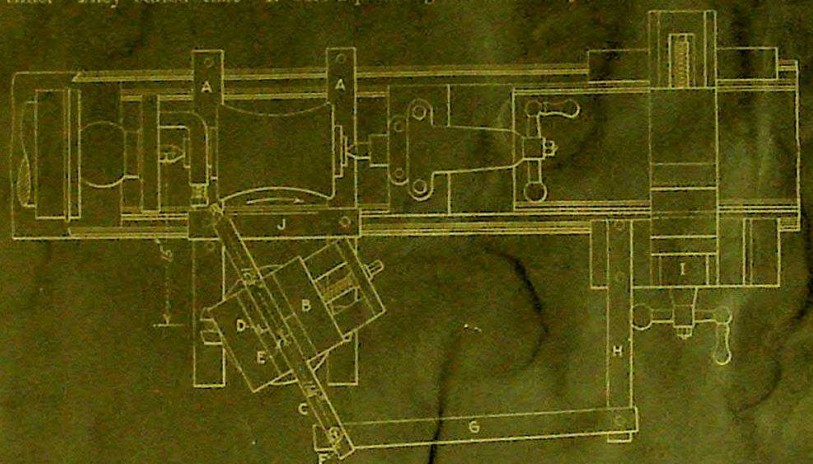

FIG. 2. LATHE SET UP FOR MACHINING THE WORM. MACHINING A LARGE ALBRO WORM IN THE ENGINE LATHE

After the blank was turned to size, the lathe was geared for 1-in. lead, and careful measurements were taken as the work progressed, with the result that a very good job was turned out in a remarkably short time.

The big laugh was on the foreman of the marine shop when he called the next forenoon to see how we were getting along. We had just completed the job and cleared the lathe. He confessed that they had tried it and asked us to show him how it was done.

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Fig. 2.

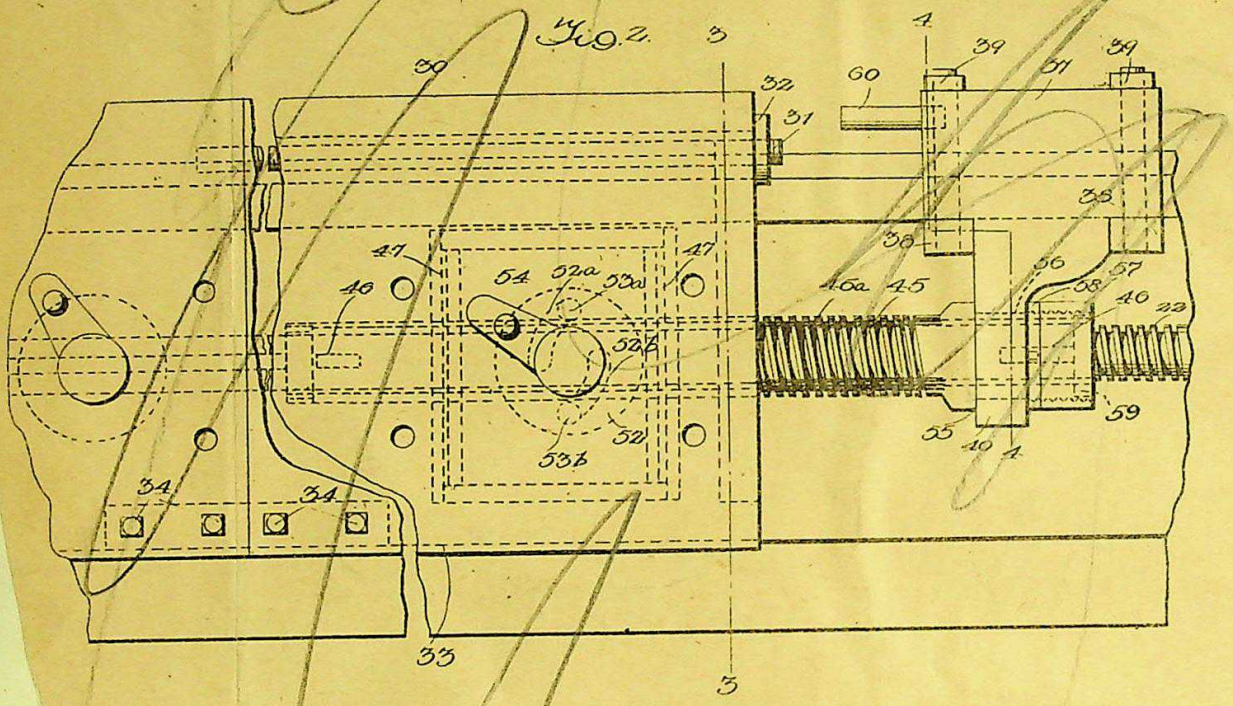

Fig. 6.

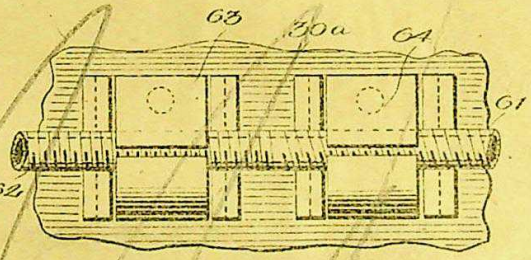

Fig. 5.

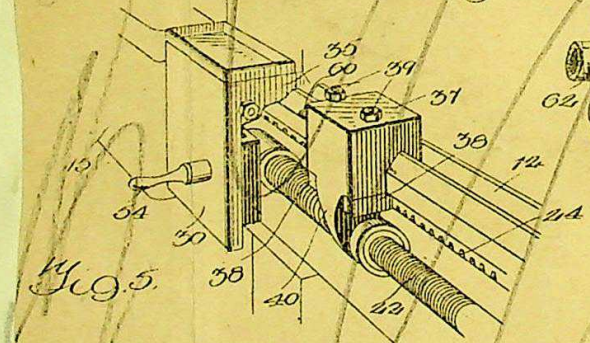

Fig. 7.